

In the Specification

Before paragraph [0001] insert the following paragraph:

Cross Reference to Related Application

This Application claims priority of Japanese Application No. 2003-121373 filed April 25, 2003, and Japanese Application No. 2004-099270 filed March 30, 2004.

Please replace paragraph [0001] as follows:

BACKGROUND OF THE INVENTION

[[1.]] Technical Field of the Invention

[0001] The ~~present invention~~ disclosure relates to a foamed polyimide shaped article and a process for production of the same, more particularly relates to a foamed polyimide shaped article having heat resistance and molded into any shape and a process for production of the same.

Please replace paragraph [0002] as follows:

BACKGROUND

2. Description of the Related Art

[0002] In the past, as a foam, a urethane-based, polystyrene-based, or polyolefin-based one has been well known. When making shaped articles from these foams, the foam is converted into chips and utilized again as cushions for seats or industrial insulating materials by being shaped with a binder. These foamed shaped articles have heat resistances of about 100°C and therefore have been limited in range of used temperature.

Please replace paragraph [0005] as follows:

SUMMARY OF THE INVENTION

[0005] ~~An object of the present invention is~~ It would therefore be advantageous to provide a foamed polyimide shaped article having heat resistance and molded to any shape and a process for production of the same.

Please replace paragraph [0006] as follows:

SUMMARY

[0006] ~~To attain the above object, according~~ According to a first aspect of the invention, there

is provided a foamed polyimide shaped article having heat resistance and molded to any shape obtained by molding and then calcining a mixture of pulverized pieces of a pre-foamed polyimide resin mass and a heat resistant binder. According to a second aspect ~~of the invention~~, there is provided a process for production of the same comprising pulverizing a pre-foamed polyimide resin mass, mixing the pulverized pieces with a heat resistant binder, molding the mixture to a predetermined shape, then calcining it at a temperature of at least 350°C to cure the binder and strongly bond the pieces of polyimide foam. In this specification, a heat resistant binder means one where no deterioration is substantially recognized after a heat treatment test at 300°C for 60 minutes.

Please replace paragraph [0007] as follows:

[0007] ~~According to the present invention, it~~ It is possible to obtain a foamed polyimide shaped article light in weight, high in heat resistance, and superior in cushioning and heat insulation. The foamed polyimide shaped article is also superior in audio characteristics. According to the method ~~of the present invention~~, it is possible to produce foamed polyimide having the above features and molded to any shape by a simple operation.

Please replace paragraph [0008] as follows:

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] These and other ~~objects and features of the present invention~~ will become clearer from the following description of ~~the preferred embodiments~~ aspects given with reference to the attached drawings, wherein:

FIG. 1 is a photograph of a foamed polyimide shaped article placed on a table as an example ~~of the present invention~~,

FIG. 2 is a view showing the dimensions of a foamed polyimide shaped article obtained in an ~~example of the invention constituted by~~ Example 5, and

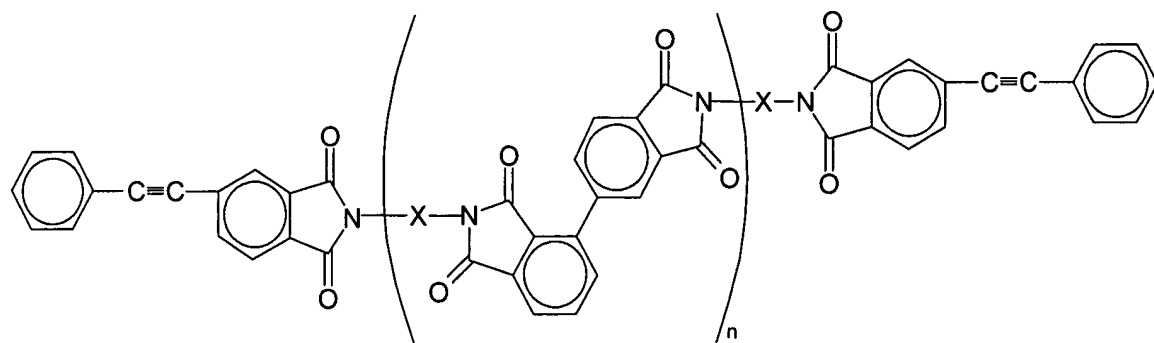
Fig. 3 is another photograph of foamed polyimide shaped articles as examples ~~of the present invention~~.

Please replace paragraph [0009] as follows:

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] Preferred ~~embodiments of the present invention~~ aspects are described below:

- 1) The foamed polyimide shaped article wherein the pre-foamed polyimide resin mass is comprised of a polymer obtained using as an essential component a 2,3,3',4'-biphenyl tetracarboxylic acid component as an aromatic tetracarboxylic acid component.
- 2) The foamed polyimide shaped article wherein the pre-foamed polyimide resin mass is obtained using as a diamine component a diamine having two amino groups in a molecule or an amine compound comprised of a mixture of diamine having two groups and ones having three or more groups.
- 3) The foamed polyimide shaped article wherein said heat resistant binder is an end-modified imide oligomer.
- 4) The foamed polyimide shaped article wherein said heat resistant binder is an end-modified imide oligomer obtained by reacting a biphenyl tetracarboxylic acid, an aromatic diamine compound, and 4-(2-phenylethynyl)anhydrous phthalic acid and having a logarithmic viscosity (η_{inh} , 30°C, 0.5 g/100 ml solvent, solvent: N-methyl-2-pyrrolidone) of 0.05 to 1.
- 5) The foamed polyimide shaped article wherein the heat resistant binder is an end-modified imide oligomer of the formula:



(wherein, X is an aromatic diamine residual group and n is an integer).

- 6) The foamed polyimide shaped article wherein the heat resistant binder has a melt viscosity at the temperature of use of 1 to 1000000 poise.
- 7) The foamed polyimide shaped article wherein the heat resistant binder has a glass transition temperature (T_g) of at least 300°C after calcining (curing by heating) and a flexural strength of at least 1300 kgf/cm².

- 8) The foamed polyimide shaped article wherein the heat resistant binder is mixed into the pulverized pieces of the pre-foamed polyimide resin mass at a ratio of 2 to 30 wt%.
- 9) The foamed polyimide shaped article having a heat resistance free from changes in appearance after a heat resistance test at 300°C for 60 minutes.
- 10) The foamed polyimide shaped article wherein the density is 0.01 to 0.8 g/cm³.
- 11) The process for production of a foamed polyimide shaped article wherein the heat resistant binder has a melt viscosity at the temperature of use of 1 to 1000000 poise.
- 12) The process for production of a foamed polyimide shaped article wherein the heat resistant binder is a polyamic acid obtained using as an essential component a 2,3,3',4'-biphenyl tetracarboxylic acid component as an aromatic tetracarboxylic acid component.
- 13) The process for production of a foamed polyimide shaped article wherein the pre-foamed polyimide resin mass has a density of 0.0005 to 0.1 g/cm³.

Please replace paragraph [0010] as follows:

[0010] ~~In the present invention, the~~ The pre-foamed polyimide resin mass preferably is obtained by evaporating to dryness a polyimide foam precursor mixture containing a half ester of an aromatic tetracarboxylic acid obtained by reacting an aromatic tetracarboxylic acid dianhydride and an alcohol, diamine, and an alcohol, powdering it, then premolding it to prepare a suitable green body and further heating it to cause foaming. Before this heating, it is also possible to perform microwave heating.

Please replace paragraph [0020] as follows:

[0020] ~~In the present invention, the~~ The pre-foamed polyimide resin mass obtained by the above foaming step can be adjusted to any expansion rate, but preferably it has a density of 0.0005 to 0.1 g/cm³.

Please replace paragraph [0021] as follows:

[0021] ~~In the present invention, the~~ The pre-foamed polyimide resin mass is pulverized, the pulverized pieces are mixed with a heat resistant binder, the mixture is charged into a mold having a predetermined shape, then this is pressed and calcined to a predetermined density so as to obtain a foamed polyimide shaped article.

Please replace paragraph [0023] as follows:

[0023] ~~In the present invention, it~~ It is important to mix the pulverized pieces with a heat resistant binder. As the heat resistant binder, a polyamic acid is preferred from the need of maintaining the heat resistance of the polyimide and functioning as a binder. In particular, as a polyamic acid for a binder, a polyamic acid obtained from an aromatic tetracarboxylic acid component, preferably an asymmetric aromatic tetracarboxylic acid component and aromatic diamine, or a polyamic acid obtained from an aromatic tetracarboxylic acid component and meta-substituted aromatic diamine or other polyamic acid giving a heat resistant heat fusing polyimide is suitable. In this method, the polyamic acid of the binder may be used in a powdered state of polyamic acid or may be used in a solvent solution. When used as a solvent solution of polyamic acid, the concentration of the polyamic acid is suitably about 1 to 20 wt% or so.

Please replace paragraph [0028] as follows:

[0028] ~~In the present invention, it~~ It is possible to charge a mixture of pulverized pieces of a polyimide foam mass and heat resistant binder into a mold having a predetermined shape, then pressing and calcining the same under a predetermined density so as to obtain a foamed polyimide shaped article. The "calcining" includes curing by heating. As the mold, one made of a heat resistant material, for example, a metal, preferably a stainless steel mold can be used.

Please replace paragraph [0030] as follows:

[0030] The polyimide shaped article ~~of the present invention~~ preferably has no change in appearance or has a heat resistance having a loss in mass of not more than 1%, in a heat resistance test at 300°C for 60 minutes. Further, the foamed polyimide shaped article ~~of the present invention~~ has a density of 0.01 to 0.8 g/cm³ depending on the molding conditions selected. Further, the foamed polyimide shaped article preferably has a density of 1.2 to 20 times the pre-foamed polyimide resin mass and pulverized pieces of the same. The polyimide shaped article ~~of the present invention~~ preferably has a tensile strength of not less than 10 PKa, more preferably of not less than 25 PKa. Further, the foamed polyimide shaped article ~~of the present invention~~ can be made a foamed polyimide shaped article of any of a sheet shape, pipe shape, column shape, cube shape, or box shape depending on the mold selected. In particular, it may be made a foamed polyimide shaped article of a pipe shape having an inside diameter of 10 to 1000

mm and outer diameter of 15 to 2000 mm or a block shape having sides A, B, and C, where A, B, and C are independently from 10 to 3000 mm.

Please replace paragraph [0046] as follows:

[0046] While the ~~invention has~~ article and method have been described with reference to specific ~~embodiments~~ aspects chosen for purpose of illustration, it should be apparent that numerous modifications could be made thereto by those skilled in the art without departing from the basic concept and scope of the ~~invention~~ disclosure.